Draft New Hampshire and Rhode Island High School Grade-Span Expectations
Edit of grade 9-10 GSEs

This DRAFT set of Rhode Island and New Hampshire Grade-Span Expectations (GSEs) for grades 9–10 includes expectations that will be assessed on the state-level assessment

Number and Operations		
Grade 9–10 GSEs	**Grade 11-12 GSEs**	**Advanced Mathematics**
M(N&O)–10–1 No standard at this level	M(N&O)–12–1 **Demonstrates conceptual understanding of rational numbers** by knowing why a real number is rational if and only if the number's decimal expansion eventually repeats or terminates.	M(N&O)– AM-1 **Demonstrates conceptual understanding of the real number system** as an extension of the rational numbers by representing real numbers as infinite decimal expansions (that provide successive rational approximations to the number) and as points on a number line. Determines whether the decimal expansion of a rational number given in fractional form eventually repeats or terminates (without using a calculator).
M(N&O)–10–2 **Demonstrates understanding of the relative magnitude of real numbers** by solving problems involving ordering or comparing rational numbers, common irrational numbers (e.g., $\sqrt{2}$, π), rational bases with integer exponents, square roots, absolute values, integers, or numbers represented in scientific notation using number lines or equality and inequality symbols.	M(N&O)–12–2 **Demonstrates understanding of the relative magnitude of real numbers** by solving problems that involve ordering or comparing any subset of the real numbers.	M(N&O)–AM–2 No standard at this level
M(N&O)–10–3 No standard at this level	M(N&O)–12–3 No standard at this level	M(N&O)–AM–3 No standard at this level
M(N&O)–10–4 **Accurately solves problems** that involve but are not limited to proportional relationships, percents, ratios, and rates. (The problems might be drawn from contexts outside of and within mathematics including those that cut across content strands or disciplines.)	M(N&O)–12–4 **Accurately solves problems** involving scientific notation or uses significant digits to assess the precision of an answer. Interprets rational exponents and their relation to radicals; computes by hand in simple cases (e.g. $4^{\frac{3}{2}}$), and using a calculator when appropriate. Interprets numbers given in scientific notation and carries out computations of them with and without a calculator. Solves problems involving compound interest.	M(N&O)–AM –4 **Accurately solves problems** and demonstrates understanding of complex numbers by interpreting them geometrically and by computing with them (e, g., adding, multiplying, dividing, finding the *n*th root, or by finding conjugates). Understands complex numbers as an extension of the real numbers (e.g. arising in solutions of polynomial equations). Manipulates complex numbers using rectangular and polar coordinates. Knows the fundamental theorem of algebra and knows that non-constant polynomials always factor into linear factors over the complex numbers.
M(N&O)–10–5 No standard at this level	M(N&O)–12–5 No standard at this level	M(N&O)–AM–5 No standard at this level
M(N&O)–10–6 **Uses a variety of mental computation strategies to solve problems.** Calculates benchmark perfect squares and related square roots (e.g., 1^2, 2^2 , …, 12^2, 15^2, 20^2, 25^2, 100^2, 1000^2). Determines any whole number percentage of a number or any multiples of 100% up to 500%. Determines benchmark fractions of a number. (IMPORTANT: *The intent of this GSE is to embed mental arithmetic throughout the instructional program, not to teach it as a separate unit.*)	M(N&O)–12–6 No standard at this level	M(N&O)–AM–6 No standard at this level

Number and Operations		
Grade 9–10 GSEs	**Grade 11-12 GSEs**	**Advanced Mathematics**
M(N&O)–10–7 **Makes appropriate estimates** in a given situation by determining the level of accuracy needed and analyzing the accuracy of results. Estimates tips, discounts, and tax and estimates the value of a non-perfect square root or cube root. (IMPORTANT: *The intent of this GSE is to embed estimation throughout the instructional program, not to teach it as a separate unit.*)	M(N&O)–12–7 **Makes appropriate estimates** in a given situation by determining the level of accuracy needed and analyzing the accuracy of results. (IMPORTANT: *The intent of this GSE is to embed estimation throughout the instructional program, not to teach it as a separate unit.*)	M(N&O)–AM–7 No standard at this level
M(N&O)–10–8 **Applies properties of numbers to solve problems,** to simplify computations, or to compare and contrast the properties of numbers and number systems.	M(N&O)–12–8 **Applies properties to** determine whether a given subset of numbers is closed under a given arithmetic operation.	M(N&O)–AM–8 **Applies properties to** add and multiply numerical matrices with attention to the arithmetic properties of these operations. Algebraically and geometrically interpret vectors, vector addition, and scalar multiplication in the plane, with attention to arithmetic properties. Knows and uses the principle of mathematical induction.

Geometry and Measurement		
Grade 9–10 GSEs	**Grade 11-12 GSEs**	**Advanced Mathematics**
M(G&M)–10–1 No standard at this level	M(G&M)–12–1 No standard at this level	M(G&M)–AM–1 No standard at this level
M(G&M)–10–2 **Creates formal proofs** of propositions **(**e.g. angles, lines, circles, distance, midpoint and polygons including triangle ratios). M(G&M)–10–2 **Makes and defends conjectures, constructs geometric arguments, uses geometric properties, or uses theorems to solve problems** involving angles, lines, polygons, circles, or right triangle ratios (sine, cosine, tangent) within mathematics or across disciplines or contexts (e.g., **Pythagorean Theorem, Triangle Inequality Theorem**).	M(G&M)–12–2 **Creates formal proofs** of propositions **(**e.g. angles, lines, circles, distance, midpoint and polygons including triangle congruence and similarity).	M(G&M)–AM–2 **Extends and deepens knowledge and usage of proofs and proof techniques;** and uses geometric models to represent and distinguish between Euclidean and non-Euclidean Systems.
M(G&M)–10–3 No standard at this level	M(G&M)–12–3 No Standard at this level	M(G&M)–AM–3 No standard at this level
M(G&M)–10–4 **Applies the concepts of congruency** by solving problems on or off a coordinate plane involving reflections, translations, or rotations; or solves problems using congruency involving problems within mathematics or across disciplines or contexts.	M(G&M)–12–4 **Applies the concepts of congruency** by using matrices to represent reflections, translations, and rotations.	M(G&M)–AM–4 No standard at this level
M(G&M)–10–5 **Applies concepts of similarity by solving problems** within mathematics or across disciplines or contexts.	M(G&M)–12–5 **Applies the concepts of similarity** of right triangles with the trigonometric functions defined as ratios of sides of triangles, and **uses the ratios of the sides of special right triangles** (30^0-60^0-90^0 and 45^0-45^0-90^0) to determine the sine, cosine and tangent (30^0,45^0, 60^0) and solve related problems.	M(G&M)–AM–5 No standard at this level
M(G&M)–10–6 **Solves problems involving perimeter, circumference, or area** of two-dimensional figures (including composite figures) or **surface area or volume** of three-dimensional figures (including composite figures) within mathematics or across disciplines or contexts.	M(G&M)–12–6 **Solves problems involving** angles, lengths and areas of polygons by applying the trigonometric formulas (law of sines/cosines, $A = \frac{1}{2}ab\sin C$) ; and applies the appropriate unit of measure.	M(G&M)–AM–6 **Solves problems involving** volume using Cavalieri's principle and **derives** and **uses** formulas for lengths of arcs and areas of sectors and segments of circles.

Geometry and Measurement		
Grade 9–10 GSEs	**Grade 11-12 GSEs**	**Advanced Mathematics**
M(G&M)–10–7 **Uses units of measure appropriately and consistently when solving problems across content strands; makes conversions within or across systems and makes decisions concerning an appropriate degree of accuracy in problem situations** involving measurement in other GSEs.	M(G&M)–12–7 **Uses informal concepts of successive approximation, upper and lower bounds, and limits in measurement situations** (e.g., use successive approximation to find the area of a pond); **uses measurement conversion strategies** (e.g., unit/dimensional analysis).	M(G&M)-AM-7 **Uses radian measure appropriately** when solving problems; **converts** between radian measure and degree measure; and understands why radian measure is useful.
M(G&M)–10–8 No standard at this level.	M(G&M)– 12-8 No standard at this level	M(G&M)- AM-8 No standard at this level
M(G&M)–10–9 **Solves problems on and off the coordinate plane** involving distance, midpoint, perpendicular and parallel lines, or slope.	M(G&M)—12-9 **Solves problems involving** circles as loci of points in the plane satisfying certain distance requirements, and **uses** the distance formula to obtain equations for circles.	M(G&M)–AM–9 **Solves problems using analytic geometry** (including three-dimensions) **and circular trigonometry** (e.g., find the equation of a circle inscribed in a triangle; find the distance between opposite vertices in a rectangular solid); **explores and interprets the characteristics of conic sections graphically and algebraically** including understanding how different planar slices of a double cone yield different conic sections; knows the characterization of conic sections as loci of points in the plane satisfying certain distance requirements, and uses the distance formula to obtain equations for the conic sections.
M(G&M)–10–10 **Demonstrates conceptual understanding of spatial reasoning and visualization** by sketching or using dynamic geometric software to generate three-dimensional objects from two-dimensional perspectives, or to generate two-dimensional perspectives from three- dimensional objects, or by solving related problems.	M(G&M)–12-10 **Demonstrates conceptual understanding of spatial reasoning and visualization by** performing and justifying constructions with compass and straightedge or dynamic geometric software.	M(G&M)- AM-10 No standard at this level

Functions and Algebra		
Grade 9–10 GSEs	**Grade 11-12 GSEs**	**Advanced Mathematics**
M(F&A)–10–1 **Identifies, extends, and generalizes a variety of patterns** (linear and nonlinear) represented by models, tables, sequences, or graphs to solve problems.	**M(F&A)–12-1 Identifies arithmetic and geometric sequences** and finds the nth term; then **uses the generalization** to find a specific term.	M(F&A)–AM-1 **Identifies and computes partial sums of infinite arithmetic and geometric sequences,** determines when an infinite geometric series converges, and finds its sum. Connects arithmetic and geometric sequences to linear and exponential functions, respectively.
M(F&A)–10–2 **Demonstrates conceptual understanding of linear and nonlinear functions and relations** (including characteristics of classes of functions) through an analysis of constant, variable, or average rates of change, intercepts, domain, range, maximum and minimum values, increasing and decreasing intervals and rates of change (e.g., the height is increasing at a decreasing rate); describes how change in the value of one variable relates to change in the value of a second variable; or works between and among different representations of functions and relations (e.g., graphs, tables, equations, function notation).	M(F&A)–12-2 **Demonstrates conceptual understanding of linear and nonlinear functions and relations** by representing and analyzing functions in several ways; recognizing properties of functions and characteristics properties of families of functions; applying knowledge of functions to interpret, model, and solve problems; analyzing characteristics of classes of functions (polynomial, rational, and exponential) to include domain, range, intercepts, increasing and decreasing intervals and rates of change; representing functions numerically, algebraically, graphically, and verbally (i.e. in written words), recognizing properties of a function from these representations, and transfers information from one representation to another; graphing polynomial, rational and exponential functions, including vertical and horizontal shifts, stretches, and compressions as well as reflections across vertical and horizontal axes; applying knowledge of functions to interpret and understand situations, design mathematical models, and solve problems in mathematics as well as in natural and social sciences	M(F&A)—AM-2 **Demonstrates conceptual understanding of linear and nonlinear functions and relations** from a set-theoretic perspective, and operations on functions including composition and inverse including computing inverses algebraically; analyzing characteristics of classes of functions and inverse functions (exponential, logarithmic, trigonometric) to include domain, range, intercepts, increasing and decreasing intervals and rates of change, periodicity, end behavior, maximum and minimum values, continuity, and asymptotes; analyzing properties of functions including injectivity (1-1), surjectivity (onto), critical points and inflection points. Determine graphically and analytically whether a function is even, odd or neither; analyzing informally the idea of continuity and limits; recognizing properties of families of functions including logarithmic and trigonometric, and graphs them; analyzing domain restriction and the effects of it on the function and its properties.

Functions and Algebra		
Grade 9-10 GSEs	**Grade 11-12 GSEs**	**Advanced Mathematics**
M(F&A)–10–3 **Demonstrates conceptual understanding of algebraic expressions** by solving problems involving algebraic expressions, by simplifying expressions (e.g., simplifying polynomial or rational expressions, or expressions involving integer exponents, square roots, or absolute values), by evaluating expressions, or by translating problem situations into algebraic expressions.	M(F&A)–12–3 **Demonstrates conceptual understanding of algebraic expressions by** manipulating, evaluating, and simplifying algebraic and numerical expressions; adding, subtracting, multiplying and dividing polynomials; adding, subtracting, multiplying and dividing rational expressions; simplifying complex fractions; factoring quadratic and higher degree polynomials, including difference of squares; applying properties of logarithms (e.g. $\log_a b^n = n\log_a b$, $a^{\log_a b} = b$) and converting between logarithmic and exponential forms; manipulating, evaluating, and simplifying expressions involving rational exponents and radicals and converting between expressions with rational exponents and expressions with radicals.	M(F&A)–AM–3 **Demonstrates conceptual understanding of algebraic expressions by** using the remainder theorem, the factor theorem and rational root theorem for polynomials; by factoring polynomials over integer, rational, real and complex numbers.
M(F&A)–10–4 **Demonstrates conceptual understanding of equality** by solving problems involving algebraic reasoning about equality; by translating problem situations into equations; by solving linear equations (symbolically and graphically) and expressing the solution set symbolically or graphically, or provides the meaning of the graphical interpretations of solution(s) in problem-solving situations; or by solving problems involving systems of linear equations in a context (using equations or graphs) or using models or representations.	M(F&A)–12–4 **Demonstrates conceptual understanding of equality** by solving equations and systems of equations or inequalities and interpreting the solutions algebraically and graphically; by factoring, completing the square, using the quadratic formula, and graphing quadratic functions to solve quadratic equations; solving and interpreting solutions of equations involving polynomial, rational, and radical expressions; analyzing the effect of simplifying radical or rational expressions on the solution set of equations involving such expressions. (e.g. x^2/x =x for x ≠0); finding approximate solutions to equations by graphing each side as a function using technology. [Understand that any equation in x can be interpreted as the equation $f(x) = g(x)$ and interpret the solutions of the equation as the x-value(s) of the intersection point(s) of the graphs of $y = f(x)$ and $y = g(x)$.]; solving 2x2 and 3x3 systems of linear equations and graphically interprets the solutions; solving systems of linear and quadratic inequalities; solving and graphically interpreting solutions systems of equations involving nonlinear expressions.	M(F&A)–AM–4 **Demonstrates conceptual understanding of equality by** solving equations and verifying identities involving trigonometric expressions; solving, graphing and interpreting equations involving exponential and logarithmic expressions; interpreting systems as matrix equations and solving them by computing the appropriate matrix inverse and multiplication, with or without technology; applying the intermediate value theorem to find exact or approximate solutions of equations or zeros of continuous functions.

Data, Statistics, and Probability		
Grade 9–10 GSEs	**Grade 11-12 GSEs**	**Advanced Mathematics**
M(DSP)–10–1 **Interprets a given representation** (e.g., box-and-whisker plots, scatter plots, bar graphs, line graphs, circle graphs, histograms, frequency charts) to make observations, to answer questions, to analyze the data to formulate or justify conclusions, critique conclusions, make predictions, or to solve problems within mathematics or across disciplines or contexts (e.g. media, workplace, social and environmental situations). (IMPORTANT: *Analyzes data consistent with concepts and skills in M(DSP)–10–2*.)	M(DSP)-12-1 **Interprets a given representation(s)** (e.g., regression function including linear, quadratic, and exponential) to analyze the data to make inferences and to formulate, justify, and critique conclusions. (IMPORTANT: Analyze data consistent with concepts and skills in M(DSP)-11-2).	M(DSP)–AM-1 No standard at this level
M(DSP)–10–2 **Analyzes patterns, trends, or distributions in data in a variety of contexts** by determining, using, or analyzing measures of central tendency (mean, median, or mode), dispersion (range or variation), outliers, quartile values, estimated line of best fit, regression line, or correlation (strong positive, strong negative, or no correlation) to solve problems; and solve problems involving conceptual understanding of **the sample** from which the statistics were developed.	M(DSP)-12-2 **Analyzes patterns, trends, or distributions in data in a variety of contexts by calculating and analyzing** measures of dispersion (standard deviation, variance, and percentiles).	M(DSP)-AM-2 **Analyzes and interprets measures of dispersion** (standard deviation, variance, and percentiles) and **central tendency** for the normal distribution; and **interprets** the correlation coefficient and the coefficient of determination in the context of data.
M(DSP)–10–3 **Identifies or describes representations or elements of representations that best display a given set of data or situation**, consistent with the representations required in M(DSP)–10–1.	M(DSP)-12-3 **Organizes and displays one- and two-variable data using a variety of representations** (e.g., box-and-whisker plots, scatter plots, bar graphs, line graphs, circle graphs, histograms, frequency charts, linear, quadratic, and exponential regression functions) to analyze the data to formulate or justify conclusions, make predictions, or to solve problems with or without using technology.	M(DSP)-AM-3 **Uses technology to explore** the method of least squares and median-median for linear regression.
M(DSP)–10–4 **Uses counting techniques to solve contextualized problems** involving combinations or permutations (e.g., organized lists, tables, tree diagrams, models, Fundamental Counting Principle, or[sc] others).	M(DSP)-12-4 **Uses counting techniques to solve problems** in context involving combination or permutations using a variety of strategies (e.g., nCr, nPr, or n!); and finds unions, intersections, and complements of sets.	M(DSP)- AM-4 No standard at this level

Data, Statistics, and Probability		
Grade 9–10 GSEs	**Grade 11-12 GSEs**	**Advanced Mathematics**
M(DSP)–10–5 **Solves problems involving experimental or theoretical probability.**	M(DSP)-12-5 **For a probability event in which the sample space may or may not contain equally likely outcomes, predicts** the theoretical probability of an event and tests the prediction through experiments and simulations; compares and contrasts theoretical and experimental probabilities; finds the odds of an event and understands the relationship between probability and odds.	M(DSP)-AM-5 **Solves probability problems** (e.g., by applying concepts of counting, random variables, independence/dependence of events, and conditional probability).
M(DSP)–10–6 **In response to a teacher or student generated question or hypothesis** decides the most effective method (e.g., survey, observation, research, experimentation) and sampling techniques (e.g., random sample, stratified random sample) to collect the data necessary to answer the question; collects, organizes, and appropriately displays the data; analyzes the data to draw conclusions about the questions or hypotheses being tested while considering the limitations of the data that could effect interpretations; and when appropriate makes predications, asks new questions, or makes connections to real-world situations. (IMPORTANT: *Analyzes data consistent with concepts and skills in M(DSP)–10–2*.)	M(DSP)-12-6 **In response to a teacher or student generated question or hypothesis** decides the most effective method (e.g., survey, observation, research, experimentation) and sampling techniques (e.g., random sample, stratified random sample) to collect the data necessary to answer the question; collects, organizes, and appropriately displays the data; analyzes the data to draw conclusions about the questions or hypotheses being tested while considering the limitations of the data that could effect interpretations; and when appropriate makes predications, asks new questions, or makes connections to real-world situations. (IMPORTANT: *Analyzes data consistent with concepts and skills in M(DSP)–10–2*.)	M(DSP)-AM-6 No standard at this level